

# An Integrated R&D Plan for the Railroad Safety in Korea

2 December, 2005, Hong Kong

Yunok Cho, Jongbae Wang, Sanglog Kwak, Chanwoo Park

Safety Technology Research Team

Korea Railroad Research Institute

# Backgrounds

- **Cyclic occurrence of major train accidents**
  - ❖ 2003: Daegu, subway train fire accident, 191 fatalities
  - ❖ 1993: Gupo, train derailment accident, 78 fatalities
  - ❖ 1982: Kyonsan, train collisions, 54 fatalities
  
- **Environmental changes in Korea**
  - ❖ KTX (Korea Train eXpress) operation at 2004
  - ❖ Structural reform of railroad industries
  - ❖ Electrification of conventional lines
  - ❖ Preparation of TCR & TKR
  
- **Railway hazards increasing, but no integrated national safety program exists**

# Backgrounds : Need for Safety Program

- **Preparing the technical basis for the Railway Safety Act & Safety Standards**
  
- **MOCT & KRRI drove requirements for the railway safety as follows:**
  - ❖ **Nation-wide railroad safety program & safety regulations**
  - ❖ **Safety technologies : hazard analysis, risk assessment & control**
  - ❖ **Long-term safety goal & safety culture improvement**
  - ❖ **Technical exchanges with other countries for safety technology & assurance system**
  - ❖ **Integrated DB system**
  - ❖ **Basis for the execution of “Railway Safety Act”**

# Derivation of Integrated R&D Plan

- **Target : Reducing accident fatalities into half the present level**
- **Planned a research program for implementing an integrated national railway safety program as follows:**
  - ❖ **Benchmarked safety programs of other countries**
  - ❖ **Benchmarked other industries safety program : nuclear, aircraft**
  - ❖ **Drove 34 topic in 4 area to meet the requirements**
- **Through planning, 15 topics in the following 3 areas have been selected from limited R&D funds & time:**
  - ❖ **System engineering and project management**
  - ❖ **Safety management system**
  - ❖ **Techniques for assessing and preventing major accidents**
- **Details of R&D program will be discussed in this presentation**

# Summary of integrated R&D plan

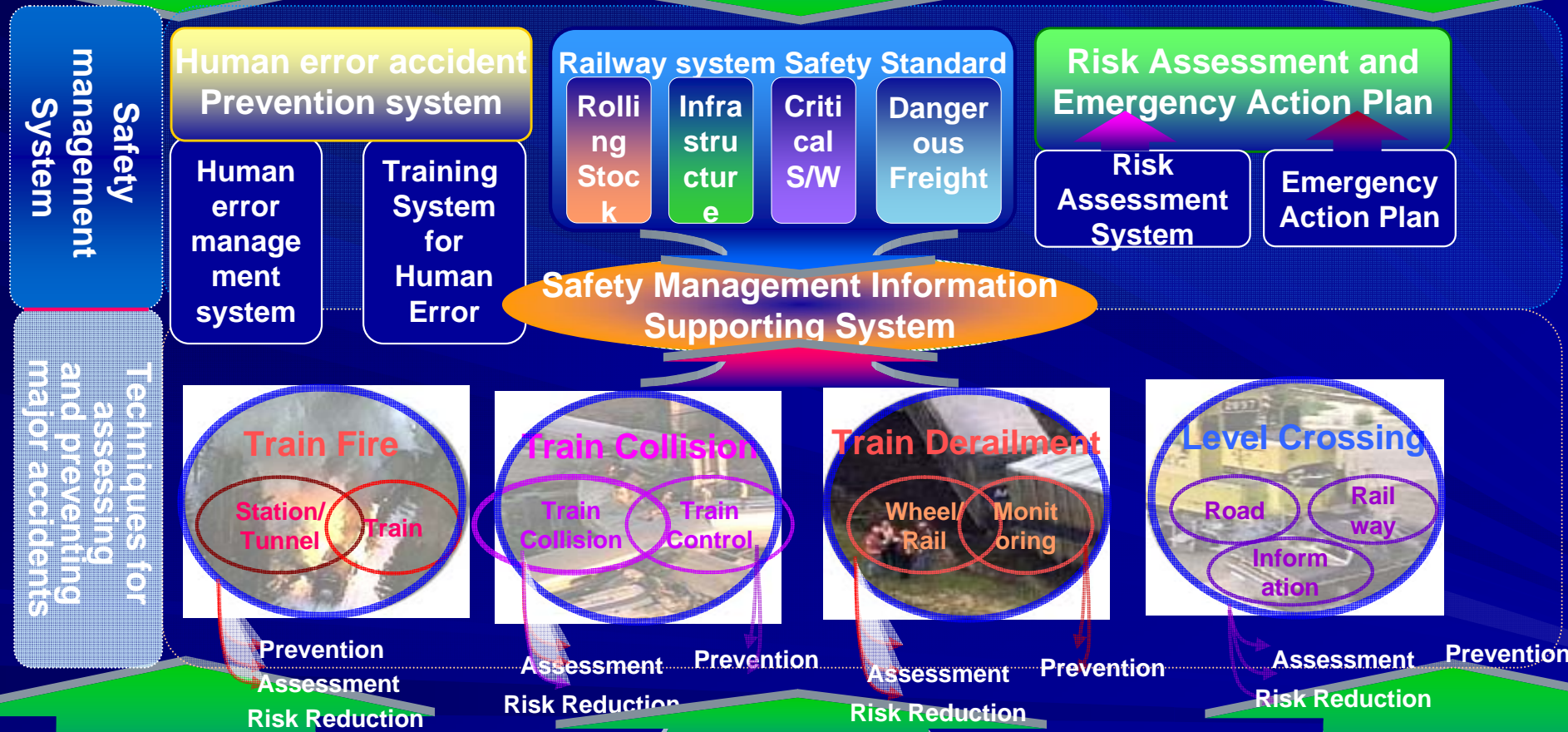
○ R&D Period: 2003 – 2010 (6 years)

○ R&D Funds: U\$ 95 million

Field	Research Subject
<b>Project Management</b>	System engineering and project management
<b>Safety management System</b>	Hazard analysis and risk assessment for safety management
	Establishment of a management system for the human error and the assessment of aptitude
	Establishment of a training system using simulators for the human error Management
	Establishment of safety standards and management system for Infrastructure
	Establishment of safety standards and management system for rolling stocks
	Establishment of safety standards and management system for safety critical S/W
	Establishment of safety standards and management system for dangerous freight operation
	Development of emergency action guidelines for designed accident scenarios
	Design and construction of an safety management information system
<b>Techniques for assessing preventing Major accidents</b>	Development of test and evaluation techniques for the fire resistance of rolling stocks and infrastructures
	Development of test and evaluation techniques for collision and the improvement of safety performances
	Development of test and evaluation techniques for derailment and the improvement of safety performances
	Development of test and evaluation techniques for train control system and the improvement of safety performances
	Development of intelligent level crossing and the improvement of safety performances

# Structure of integrated R&D plan

## Railway Safety System Engineering

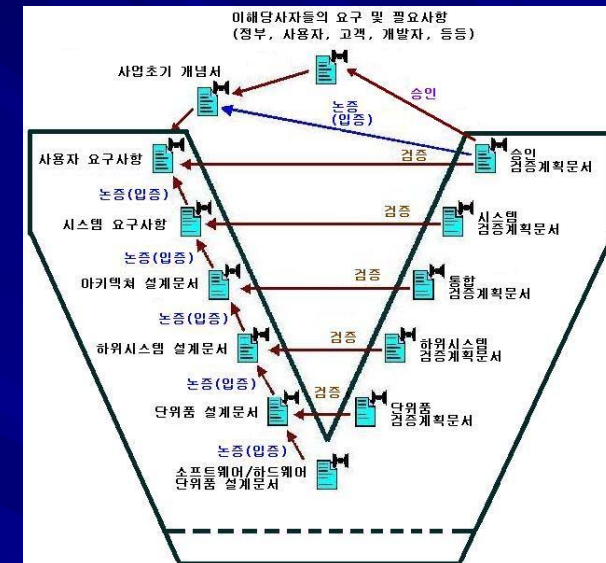


## Railway Safety System Engineering

# Details of R&D Plan (1)

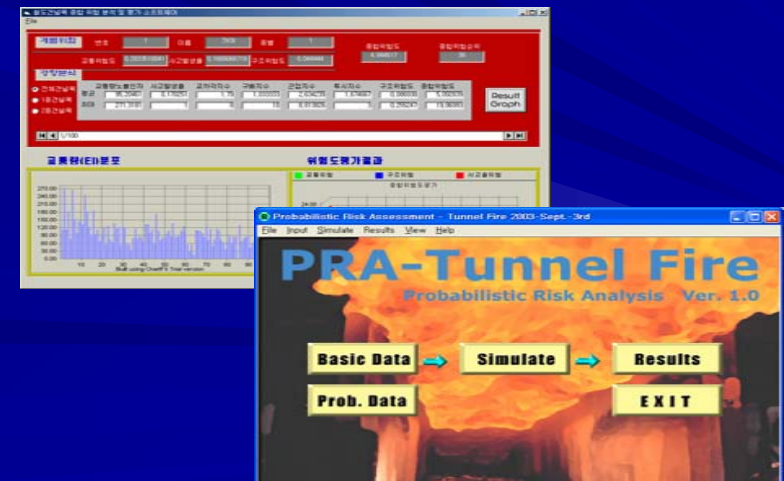
## 1. System engineering and project management

- ❖ Project management
- ❖ Interface between technologies and “Safety Act & Standard”
- ❖ Interface control among research topics
- ❖ Development of “System Safety Program”
- ❖ Restructuring and construction of “ Safety Standards”



## 2. Hazard analysis and risk assessment for safety management

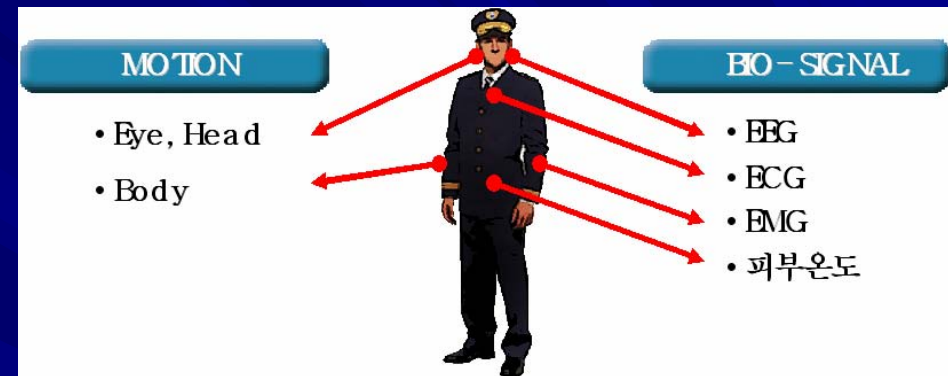
- ❖ Hazard Analysis and Classification of the identified hazards
- ❖ Development of standard risk assessment techniques
- ❖ Data Analysis for major train accidents
- ❖ Risk Quantification for major train accidents
- ❖ Probabilistic Risk Assessment (PRA)
- ❖ In connection with accident scenarios and accident DB



# Details of R&D Plan (2)

## 3. Establishment of a management system for the human error and training

- ❖ Causes analysis for human error
  - Development of human error analysis techniques
- ❖ Human factor control
- ❖ Aptitude analysis
- ❖ Work allocation guideline/Work Planning
- ❖ Correlation analysis for fatigue and stress
- ❖ Emergency action plan
- ❖ Action plan for various human errors in connection to emergency action plan



## 4. Establishment of safety standards for rolling stock, infrastructure, critical S/W and dangerous freight

- ❖ Detailed standards for all types of trains, infrastructures, safety critical S/W, and dangerous freight
- ❖ Standard for level crossing
- ❖ Rolling stock standard using fire/collision/derailment test results
- ❖ Standard for level crossing

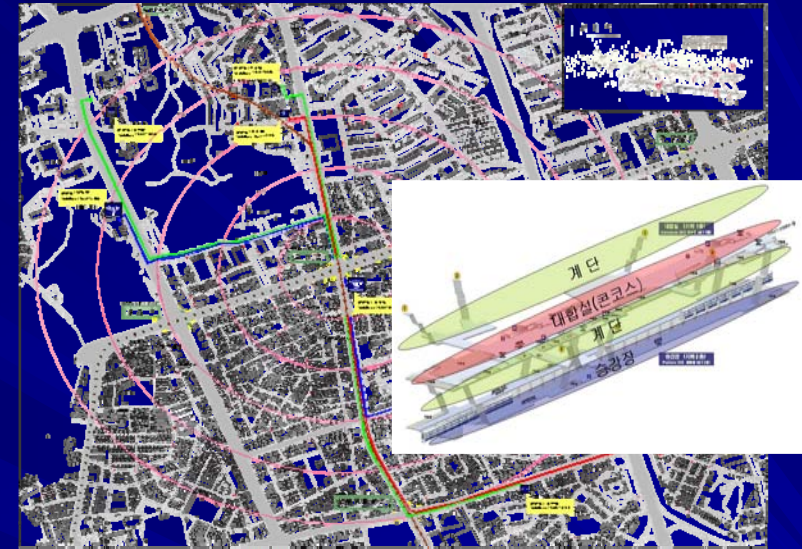




# Details of R&D Plan (3)

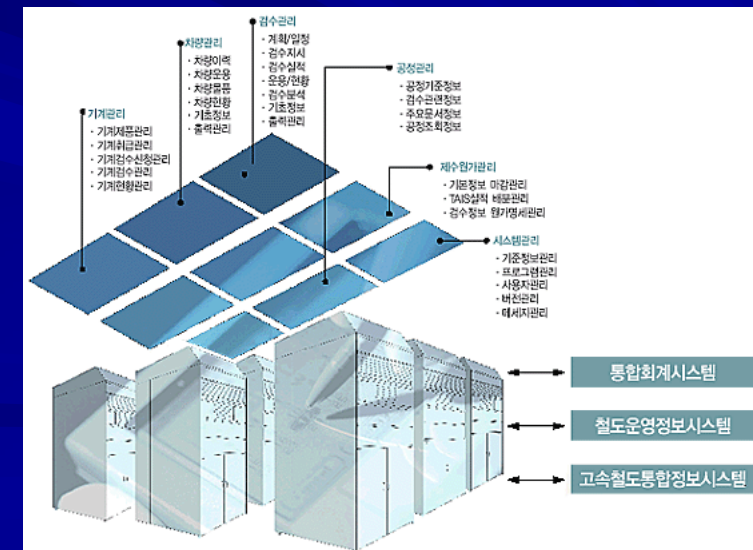
## 5. Emergency action guidelines for designed accident scenarios

- ❖ Development of accident scenario for major train accident
- ❖ Preventions of accident expansion to disastrous results
- ❖ Hazard analysis for major accident cause
- ❖ Development of emergency action plans using accident scenarios



## 6. Design and construction of a safety management information system

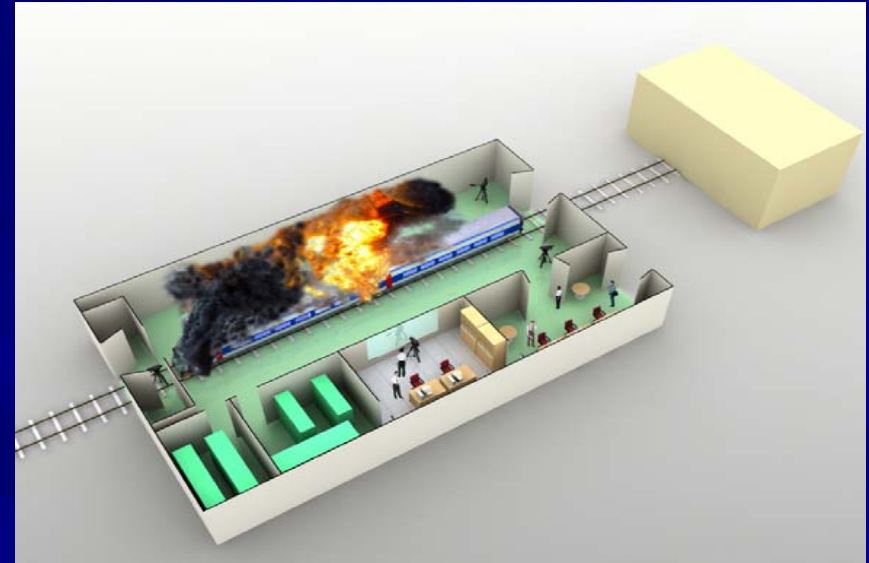
- ❖ Railroad safety DBMS constructing compatible various DBMS (regulation, operation, construction, research, accident inspection)
- ❖ Automated data gathering and support to decision-making, risk assessment
- ❖ Requirement control for safety operations
- ❖ DB are related to other research topics



# Details of R&D Plan (4)

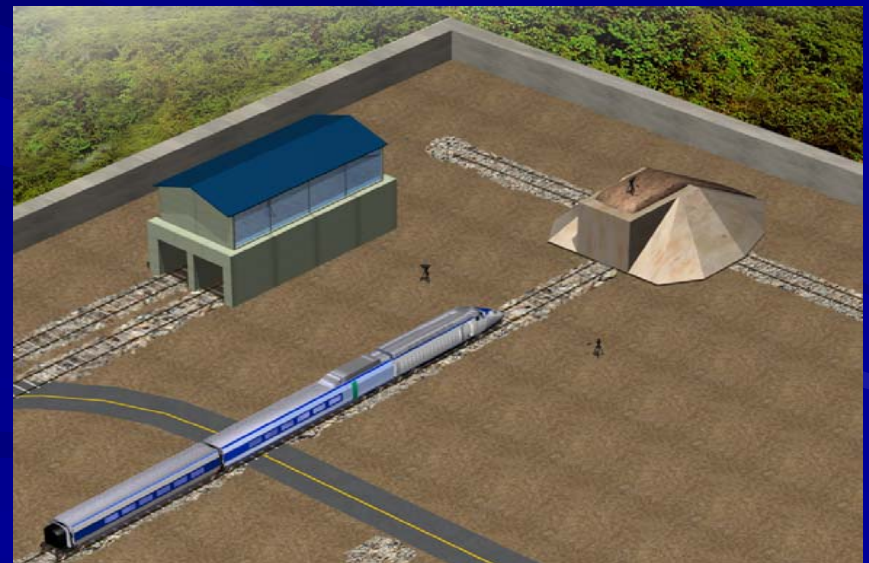
## 7. Development of test and evaluation techniques for fire resistance of rolling stock and infrastructures

- ❖ Measure for fire resistance on rolling stock & structural materials
- ❖ Guidelines for materials



## 8. Development of test and evaluation techniques for Test & evaluation techniques for collision safety and performance measures

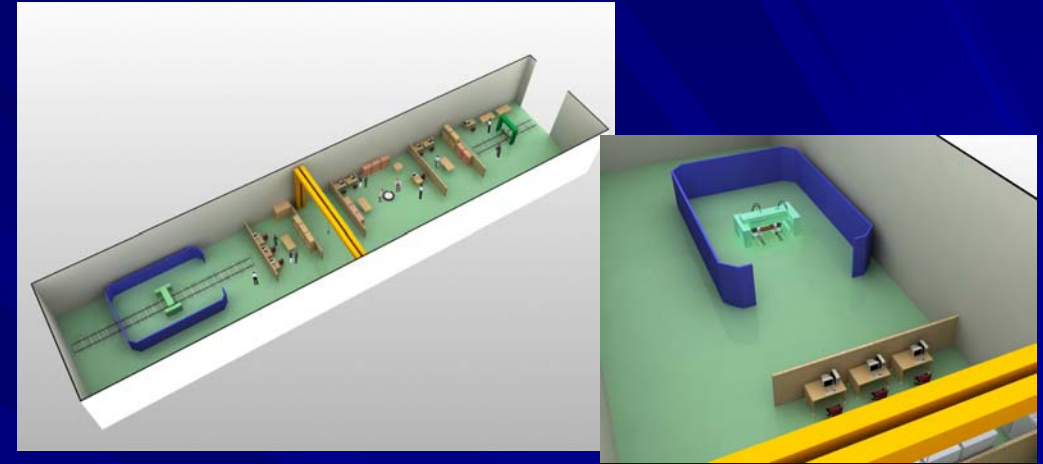
- ❖ Rolling stock collision safety performance evaluation techniques
- ❖ Design techniques for rolling stock collision safety devices
- ❖ Construction of rolling stock collision test equipments



# Details of R&D Plan (5)

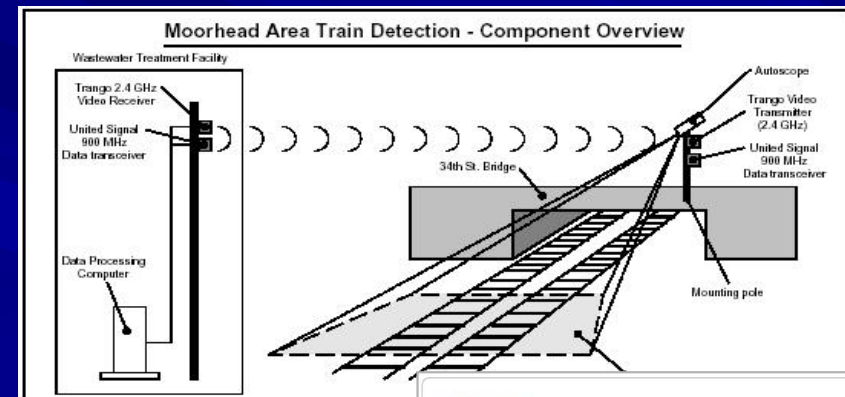
## 9. Development of test and evaluation techniques for the prevention of derailment and improvement of safety performances

- ❖ Safety performance evaluation techniques for rolling stock derailment caused by rolling stock/rail defects & environment conditions
- ❖ Safety improvement techniques of rolling stock derailment risk
- ❖ Construction of integrated monitoring system for rolling stock derailment risk



## 10. Development of intelligent level crossing

- ❖ Connection techniques between Train control devices and road traffic controller
- ❖ Intelligent level crossing techniques such as image processing and RF communication
- ❖ level crossing information supply techniques for road drivers and train drivers



# Safety System Fundamental Architecture

## Railway Safety System Engineering



- Accident Rate
- Safety Investment Priority
- Safety Investment Benefit
- .....

## Railway Safety Information System

# National Railway Integrated Safety Management System Architecture Based on System Engineering & Risk Management



# Conclusions & Plan

- **The R&D Program introduced will eventually setup the basement for executing the Railway Safety ACT efficiently until the year of 2009.**
- **Thanks for the attention!**

# Memo